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Title: NCS- Controls and PPD Response

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NCS- Controls and PPD Response

UNM-LA (NEST Program)

What is Criticality Safety?

Protection against the consequences of a criticality accident, preferably by prevention of the accident

- It is no different than any other safety discipline
  - Implementation at the floor level is by procedures and controls
  - Underlying principles can be complex and counter to *rational judgment*
    - Adding or removing water from fissionable material may both be unsafe
    - Effects of adding non-fissionable material are not always straightforward
    - Behavior of material may change depending on its distribution and location
- Criticality safety evaluations establish controls for avoiding a self-sustaining chain reaction under both
  - normal &
  - credible abnormal process conditions

Introduction

- Why is it important?

It is required by the CFR (law), DOE, and LANL policy

But more importantly:

It is for YOUR safety when working with or near fissionable materials!

An accident is *PREVENTED* by analyzing the operations in the facility and implementing controls at the facility level

Typical Practice

- Operations proposes a new process or a change to an existing process

- Criticality Safety staff analyze the system
  - Ensure the entire process remains subcritical under all normal and credible abnormal conditions.
  - Process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. (Double Contingency Principle)

- Criticality Safety staff work with Operations and Engineering staff to develop controls on the process

Criticality Safety Evaluation Process

Process Description

- Requirement document assists the Criticality Safety Evaluation Document (CSED)

Normal and Credible Abnormal Conditions

- Hazard analysis meeting assists in developing the process conditions

Technical Analysis

- Use of existing technical work (cf. pertinent CSEDs, TECHs, etc.)
- Develop new technical bases

Evaluation Process

NCS Requirements/Controls

- Limits on controlled parameters are derived from analysis
- Additional restrictions typically used to make the analysis tractable or in double-contingency arguments

Summary, Conclusion, Appendices

Independent Review for Adequacy

- Intermediate Review of a new, or some/most major revisions
- Independent Review of a DRAFT document that is anticipated to be issued, not required for minor revisions
- Quality Review of a document that is anticipated to be issued
- DC/RO review of the master document

Signatures

Understanding Criticality Safety Flowdown

- Criticality Safety Evaluation
  - Input from operations or knowledgeable personnel on normal and abnormal conditions
  - Determine any controlled parameters and associated limits (and how condition changes affect parameters)
  - Determination of controls and show that process will remain subcritical under all normal and credible abnormal conditions
  - Contained in CSED/CSP documentation
- Controls
  - Engineering Controls
    - Passive
    - Active
  - Administrative Controls
  - Incorporated into
    - Equipment (engineering controls)
    - Postings (administrative controls)
    - Implementation procedures

Controls

- Controls are developed to limit process parameters important to criticality safety
  - Mass
  - Absorption
  - Geometry
  - Interaction
  - Concentration/Density
  - Moderation
  - Enrichment
  - Reflection
  - Volume

- Hierarchy of Controls:
  -Natural Process Constraints
  -Passive Engineered Controls
  -Active Engineered Controls
  -Administrative Controls

- Controls must be easy to implement or people will find work-arounds

Reading CSPs/CSLAs

- Administrative Controls
  - Controls that are implemented via actions by the operator (confirming mass values, meeting container requirements, spacing between items)
- Engineered Controls
  - Controls that are already in place and are not affected by operators' actions, but confirmed to be present before start of operation
- Additional Restrictions
  - Items that are also necessary as identified in the CSED to defend assumptions made or draw boundaries around the operation considered for analysis

Criticality Safety Posting (CSP)

Criticality Safety Posting

Activity / Task

Handling Small Quantities of Fissionable Material in PF-4

TA	GB#	MC&A Location	References
55	N/A	N/A	NCS-CSED-13-015 NCS-CSED-17-022
Building	**Room**	**FMO ID**	
4	All	PF4-HAND-00	

CRITICALITY SAFETY REQUIREMENTS

Administrative Controls

Material Limits

Pu (may be any fissionable material, without regard to form or geometry) ≤ 50 g *

*Unmeasured value maybe used with acceptable process knowledge

Additional Restrictions

- Requirements of this FMO do not supersede or replace any local requirements.
- Operations personnel must continuously attend material being handled using these limits.
- Each operator may only conduct one instance of this process at a time.

Engineered Controls

- This operation has no engineered controls.

Process Description:

This FMO is the handling of small quantities of fissionable material in PF-4. The operation is executed by handling ≤ 50 g of Pu (may be any fissionable material, without regard to form or geometry). Material being handled under this FMO must be continuously attended. Operators must abide by all local requirements and guidance *in addition* to the requirements of this CSP for this FMO. Local requirements may include the criticality safety requirements of other FMOs and/or facility procedures.

Criticality Safety Posting

Activity/Task Title
Transport of Waste Containers in PF-4

TA	GB #	MC&A Location	References
55	N/A	N/A	Level 1: NCS-CSED-15-080 Level 1: NCS-CSED-12-104 Level 3: NCS-CSED-12-096
Building	**Room**	**FMO ID**	
4	N/A	PF4-CARTS-04	

CRITICALITY SAFETY REQUIREMENTS
Transport of Waste Containers in PF-4

Operational Process Requirements

Material Limits

- 55-gallon or larger waste drums ≤ 200 FGE ^{239}Pu each
- Standard Waste Boxes (SWBs) ≤ 325 FGE ^{239}Pu each

NOTE: The ≤ 200 FGE ^{239}Pu and ≤ 325 FGE ^{239}Pu limits per container may be read as ≤ 200 g Pu and ≤ 325 g Pu, respectively; plutonium isotopes shall be treated as ^{239}Pu on a gram-for-gram basis, provided the ^{241}Pu content does not exceed the ^{240}Pu content.

Additional Restrictions

- Stack containers no more than two high.
- Waste containers shall have lids in place.

Engineered Features

- Standard 55-gallon drum dimensions (≥22.6 inches in diameter and ≥34.75 inches tall)

Process Description:

- Movement of 55-gallon or larger waste drums and SWBs in PF-4.
- Unattended staging of waste containers during transient operations is allowed except in FMO floor locations (e. g. floor locations with posted limits).
- Radiological shielding (e.g., lead blanket) allowed on waste containers during movement.
- Drum dollies, pallet trucks, forklifts, etc., allowed for movement of drums and SWBs.

Evaluation of the Safety of the Situation (ESS)

- TA55-ESS-14-002 implemented by DOE
- Created for water ingress due to fire
- Gives 2 different limit sets, approved by DOE
- These limit sets must be combined with the previous technical basis

OLD LIMIT SETS

Material Limits
- Pu in Oxide ≤ 14000 g

Additional Restrictions
- All Oxide must be containerized in water-tight containers

*NOTE: A list of water-tight containers can be found in PA-RD-01009

NEW LIMITS

Material Limits
- Pu in Oxide ≤ 4500 g
- Highly-enriched uranium (HEU) may be substituted on a gram-for-gram basis for Pu

Additional Restrictions
- All Oxide must be containerized in water-tight containers

ESS LIMIT SET 1

Material Limits
- Pu in Hemishells/Waistbands/Metal/Oxide/Compounds/Dry Residue ≤ 4500 g
- Highly-enriched uranium (HEU) may be substituted on a gram-for-gram basis for Pu

Additional Restrictions
• Pu Oxide has no additional restrictions
The following additional restrictions apply to the listed Material Forms:
• Pu in Metal: Greater than 3 kg Pu metal must be transported between FMO locations in a container providing at least 1.0 cm of engineered spacing

NOTE: Hemishells and waistbands are excluded from this restriction

• Pu in Metal /Compounds/Dry Residues: Pu metal turnings, fines, other metal pieces of Pu weighing less than 5 g, or compounds or dry residues must be containerized if accumulated to greater than 500 g. Container types used for this purpose must be water-resistant such that no more than 50 ml of water ingress is allowed under flooding

What Can You Do As a Worker?

- Take criticality safety training
- Understand and be willing to follow:
  - Written procedures
  - Controls
  - Postings
  - Pause work policy
- Be aware of criticality requirements/controls/limits
- Participate in operational planning, including the development of the written procedures & criticality safety requirements for the operation

Potential Consequences of NCS Control Violation

- Potential criticality accident
- Potential for violation of 10 CFR 830 (**law**) **BIG Problem!**
- PAAA violation, potential fines
- Criticality safety infraction which could result in an operational pause or shutdown

Potential Process Deviation

- A process deviation for criticality safety is defined as any deviation from NCS controls for the operation that affects or may affect the criticality safety of any activity involving fissionable materials.
- If a non-compliance with a criticality safety control or limit is found or suspected:

1. Pause work in a safe manner, do NOT attempt to recover from the situation
2. Back away from the situation at least 15 feet
3. Promptly establish an exclusion zone such that personnel within the room are at least 15 feet away from the area of concern and control access to the affected area(s).
4. Warn others in the area to avoid the exclusion zone
5. Notify supervision and the TA55 Operations Center
6. Await further instruction in a safe location

Emergency Response

- Potential Process Deviations
  - We are all human and accidents happen
  - It is good that operations have questioning attitudes
  - NCS's duty is to respond appropriately – ensure the situation is safe and stable – and give guidance on recovery and judge severity.
  - Fact finding is held and recovery plan is made
  - Train to be prepared to respond to potential Criticality Accident

Table 3. Criticality Safety Infraction Severity Index

Infraction Description	Severity Index
All controls remain intact. A failure to comply with a criticality safety program requirement that does not adversely affect the criticality safety of a process.	5
Partial loss of control of a single parameter with two or more parameters providing criticality safety margin. The process remains within the bounds of the analysis, i.e., the process was outside of the normal conditions, but within the analyzed upset conditions.	4
Violation of a criticality safety limit or loss of a control. Total loss of control of a single parameter and that parameter is outside the bounds of the analysis, i.e., outside the analyzed upset condition or partial loss of control of more than one parameter with two or more parameters providing criticality safety margin.	3
Total or partial loss of control of one or more parameters with only one FULLY intact parameter providing criticality safety margin.	2
Total or partial loss of control of one or more parameters with no parameters remaining to provide criticality safety margin such that a criticality accident is possible.	1
Operations are being conducted with fissionable materials such that a Criticality Safety Evaluation (CSE) would have been required under Section 3.2.1; no analysis has been conducted, and no credited controls are in place.	1-NC
Criticality accident occurs.	0

Potential Process Deviations- Photo Op

- Can be as trivial as a typo
- Can be as serious as an over-massed location

–2011 photo-op example

- Most called out of an abundance of caution
- Vast majority are very safe and nowhere near a critical configuration due to conservatism built into everything we do

Photo Op Cont.

Photo Op Cont.

Accident Circumstances

Criticality accidents have occurred when …

- Equipment or processes were modified but not evaluated
- Procedures were not followed
- Performing non-standard operations
- Communications have failed
- Working late at night or off-normal shifts
- Working alone

Conclusion

- Be aware that an unexpected item or unusual occurrence could reduce your safety margin
- Submit any new activity through the new activity screening process so it can be evaluated (both for new material and new operations) to determine if captured by the safety envelope of the CSED
- Whenever something unusual or unexpected is noticed, contact your CSO and supervisor
  - Stop Work, do not manipulate anything (may close doors to prevent contamination/airborne spread)
  - THEN evacuate at least 15 feet away from the issue location
  - Wait for the situation to be properly evaluated

Points to Remember

- Criticality Safety is very important--knowledgeable operators like you can make a real difference in keeping us all safe.
- Follow Criticality Safety requirements at all times.
- Know how to identify a violation of the criticality safety requirements.
- **STOP–STAND BACK–CONTROL ACCESS–CALL OPS CENTER–WAIT**
- – Do not attempt to recover!
- If you even <u>think</u> something is not right, ask the question.

Conclusion

- **NEVER** underestimate the potential for criticality
- **ALWAYS** follow your procedures
- **REMEMBER** NCS Parameters (MAGIC MERV)

Whenever something unusual or unexpected is noticed:

1. Pause work in a safe manner, do NOT attempt to recover from the situation
2. Back away from the situation at least 15 feet
3. Promptly establish an exclusion zone such that personnel within the room are at least 15 feet away from the area of concern and control access to the affected area(s).
4. Warn others in the area to avoid the exclusion zone
5. Notify supervision and the TA55 Operations Center
6. Await further instruction in a safe location

Questions

- ????

Quiz: UNM-LA NEST (NCS Controls/PPD Quiz)

1. What is the main cause of the criticality accidents discussed?
    a. Equipment failure
    b. Operators not following procedure
    c. Incorrect mass limits
    d. Lack of a criticality accident alarm system

2. During a potential process deviation, when the operator(s) back away 15 feet, what radiation protection concept are they practicing?
    a. Time
    b. Distance
    c. Shielding
    d. Exposure

3. Criticality safety evaluations establish controls for avoiding a self-sustaining chain reaction under both normal and credible abnormal conditions.
    a. True
    b. False

4. Which of the following is the correct course of action if a known or suspected criticality safety infraction is identified?
    a. Attempt to the recover from situation
    b. Call the Ops Center, but continue work in the area
    c. Stop work, move 15 feet away, control access to the area, call the Ops Center, and wait for additional instruction
    d. Send a notification to Criticality Safety, and continue work in the area

5. What type of controls are implemented via actions by the operator (confirming mass values, meeting container requirements, spacing between items)?
    a. Administrative Controls
    b. Engineered Controls
    c. Passive Engineered Controls
    d. Additional Restrictions

6. What type of controls are already in place and are not affected by operators' actions (but confirmed to be present before start of operation)?
    a. Administrative Controls
    b. Engineered Controls
    c. Passive Engineered Controls
    d. Additional Restrictions

7. Criticality Safety staff DO NOT work with Operations and Engineering staff to develop controls on the process.
    a. True
    b. False

8. What are some of the main potential consequences of an NCS violation discussed?
    a. Receiving a promotion
    b. Potential criticality accident
    c. No consequence
    d. Potential for violation of 10 CFR 830
    e. Criticality safety infraction which could result in an operational pause or shutdown

9. What should you do if you notice something is not right within an operation?
    a. Nothing
    b. STOP-STAND BACK- CONTROL ACCESS- CALL OPS CENTER- WAIT
    c. Attempt to recover from situation
    d. Freak out

10. As a worker it is important that you understand and be willing to follow: Written procedures, Controls, Postings, Pause work policy.
    a. True
    b. False